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A BERLESE FUNNEL FOR COLLECTING SMALLER SOIL ANIMALS

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In recent years a number of investigators have become interested in determining the numbers of small, often poorly pigmented and blind arthropods, termed collectively "microgenton" by Silvestri, that live in arable soils. While substantial progress has been made, many workers have felt that the methods used in such quantitative studies are not sufficiently accurate. There is especially a need for improvement in methods of extracting or separating very small arthropods from the soil. During the course of studies of the smaller soil animals in cotton fields, a type of Berlese funnel was evolved which gave relatively accurate separation. This funnel, in common with other described models, utilizes heat from a light bulb as a force motivating the downward migration of organisms into a catching basin below.

For convenience in description, the parts of the funnel are designated in figure 1 as (A) the hopper, (B) the cone, (C) the spout, (D) the soil container, and (E) the lid and heating unit. Galvanized sheet metal is the basic material and it must be of a weight that will make a sturdy product.

The hopper or upper portion of the funnel pictured is 14 inches in diameter and 14 inches deep. The cone or middle portion of the funnel is 2 feet in length; at its top it has a diameter of 14 inches; at its lower end, where it joins the spout, it has been constricted to a diameter of 2 inches. The result is a steep slope which causes falling organisms to reach the catching vessel below more quickly. The lower portion of the funnel, the spout, is constructed so as to fit into the top of a milk bottle which is used to catch the organisms. At its top the spout is 2 inches in diameter and at its lower end it is 1 inch in diameter. A large opening in the spout is desirable, as otherwise falling soil might clog the opening.

Inside of the funnel, at the junction of the hopper and cone, two strong iron rods are inserted to form a cross bar to support a special container fashioned to contain soil samples. It was deemed advisable to have a separate soil container, unattached to the rest of the apparatus, so as to facilitate cleaning after use. The soil container is constructed with a smaller diameter than the hopper so as to allow circulation of air on the inside and to reduce the probability of condensation of moisture on the walls. In the apparatus pictured, the soil container is 12 inches in diameter and the same height as the hopper, into which it fits loosely. Best results were obtained in containers of this

size with soil samples of approximately 300 cubic inches. The lower end of the soil container is covered with wire screen. One-eighth inch mesh has been found to be a most serviceable size.

The top of the funnel is covered with a loosely fitting galvanized-metal lid which has an electric light socket soldered in its middle. When equipped with a 200-watt bulb, this lid serves as a cover for the apparatus and as a support for the heating unit as well. Three small vents are cut in the lid to further aid air circulation and removal of water vapor.

The funnel is mounted upon three legs, which are fastened to the apparatus at the junction of the hopper and cone at one end, and to a hoop at the other end. The hoop rests upon the ground, serving to steady the apparatus.

When soil samples are being placed in the soil container, a considerable quantity of soil usually sifts through. This is caught in a sack and is later added to the soil within the funnel. The catching vessel containing water may be placed underneath when no more soil falls. Funnels must be cleaned after each usage, as small spiders may construct webs across the opening of the spout.

This apparatus has been used by the writer to collect thrips on cotton and fleas in the nests of wood rats, as well as for collecting soil organisms. In all instances it proved to be very serviceable. When it is used for anything besides soil, it may be necessary to reduce the intensity of heat within by substituting a smaller bulb, or to eliminate heat entirely, cover the top of the apparatus with cloth instead, and let slow desiccation drive the organisms out.

Water is used in the catching bottles because most smaller soil organisms will float on its surface. After being stupefied with ether or chloroform, these may be removed by means of a wire loop. Certain kinds which invariably sink can be located only by close binocular examination of the water and sediment in it. If an immediate examination of a Berlese catch is not possible, a killing and preserving fluid may be used instead of water.

The length of time that is necessary to drive all organisms from soil varies with soil texture, soil structure, soil moisture, thickness of soil column, etc., or, in other words, with any factor affecting downward transmission of heat. With light-textured soils worked with in Arizona, only from 6 to 10 hours were required. With Sacramento clay, a soil with much organic matter and a high colloidal clay content, from 2 to 4 days of heating were necessary to obtain all organisms. In both cases, 301.59 cubic inches of soil were placed in the funnels. This is the soil quantity contained in 2 soil aliquots, 4 inches in diameter and 12 inches in length, the normal capacity of the funnels used. It would seem undesirable to shorten the period of operation in the case of light-textured soils, by providing more intense heat. Some of the organisms move slowly and require considerable time to reach the bottom of the soil layer. When heavy clays are being studied, it may be desirable to use resistance coils in place of light bulbs, thus increasing the heat intensity and hastening the separation process. Complete extraction of

organisms is determined by trial, substituting clean catching bottles from time to time.

The efficiency of the Berlese funnel under all conditions has not been determined. One investigator has shown that Tardigrada cannot be collected by this means. These minute animals encyst at the first increment of heat and are killed. In one test of the apparatus described, 64 percent of a representative group of soil animals introduced into sterilized soil was recovered. In other tests, better than 95 percent of a group of Collembola was recovered. In comparison with others, the Berlese method was found to be much superior.

Soil samples are taken from the field with a modified peat tube constructed for the purpose. As this tube circumscribes a known area, results can be expressed quantitatively.

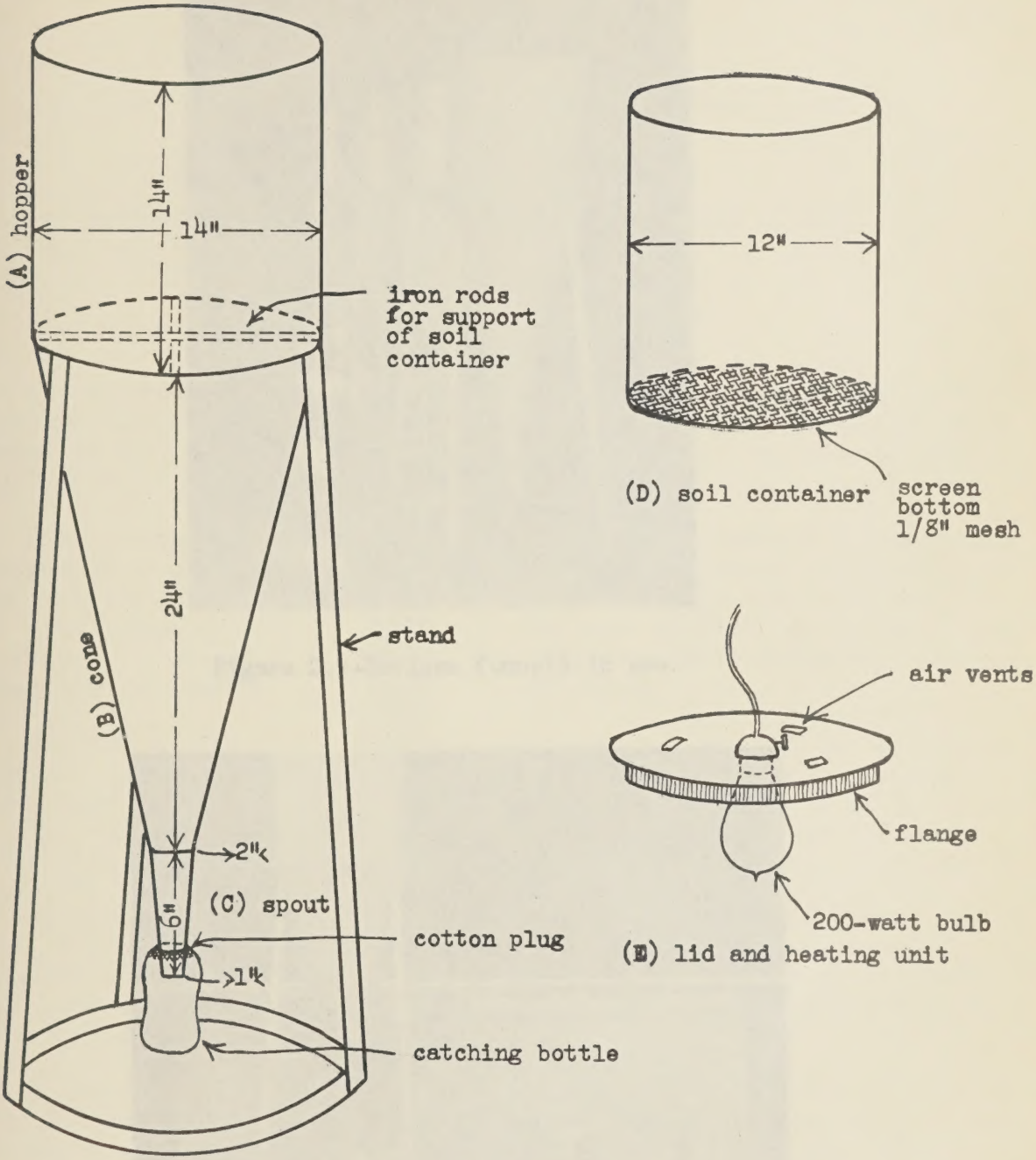
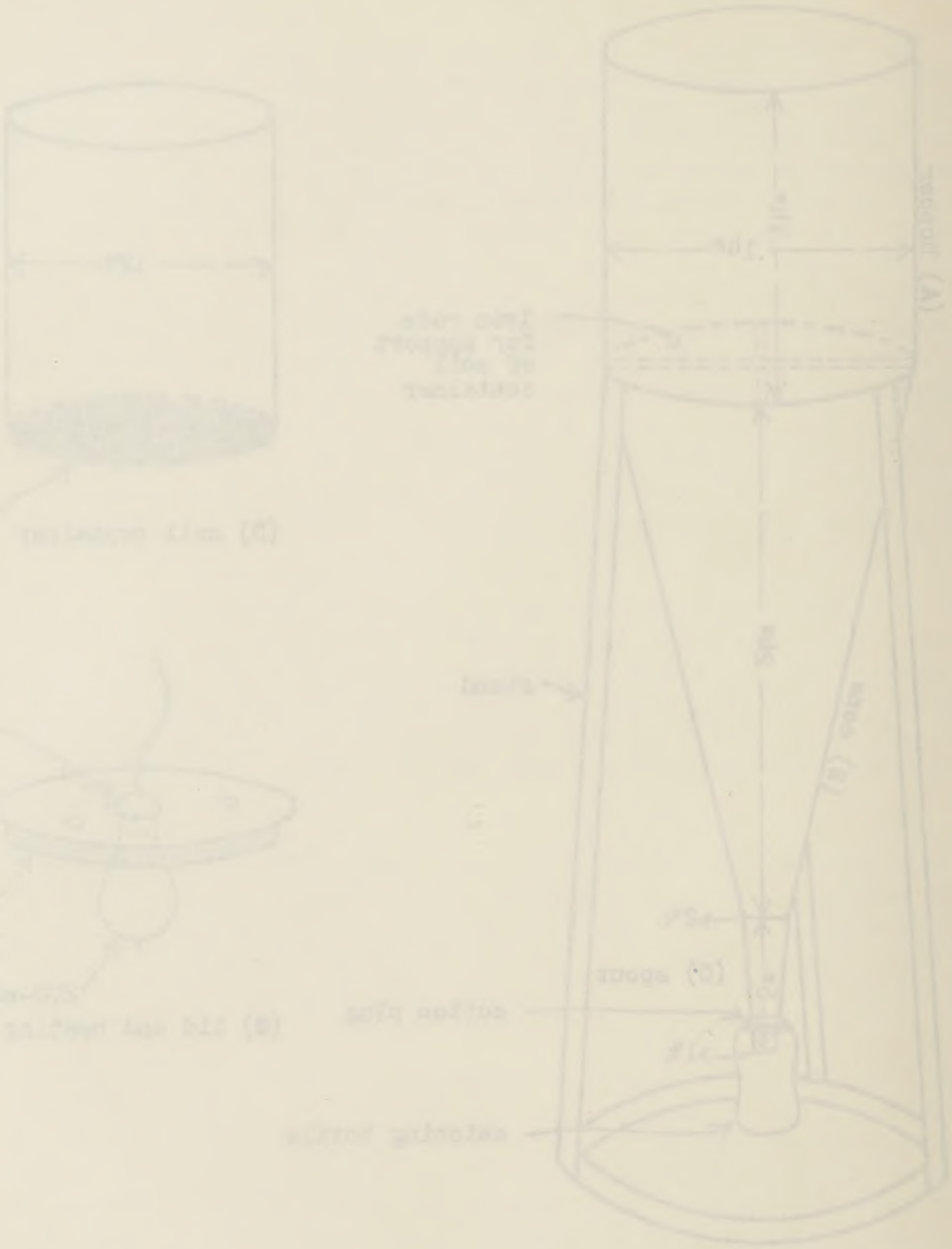


Figure 1.--Berlese funnel. In operation, the soil container rests upon iron cross bars in the hopper and has the lighted bulb extending down into it.



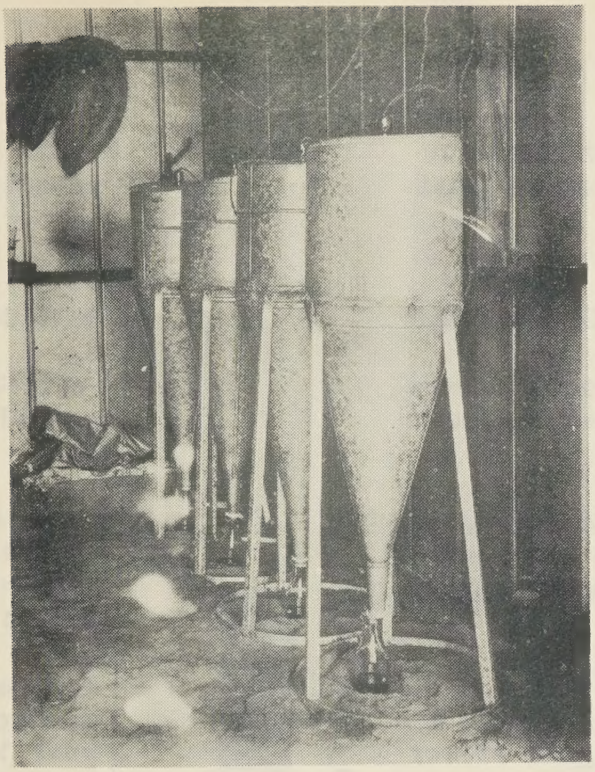


Figure 2.--Berlese funnels in use.

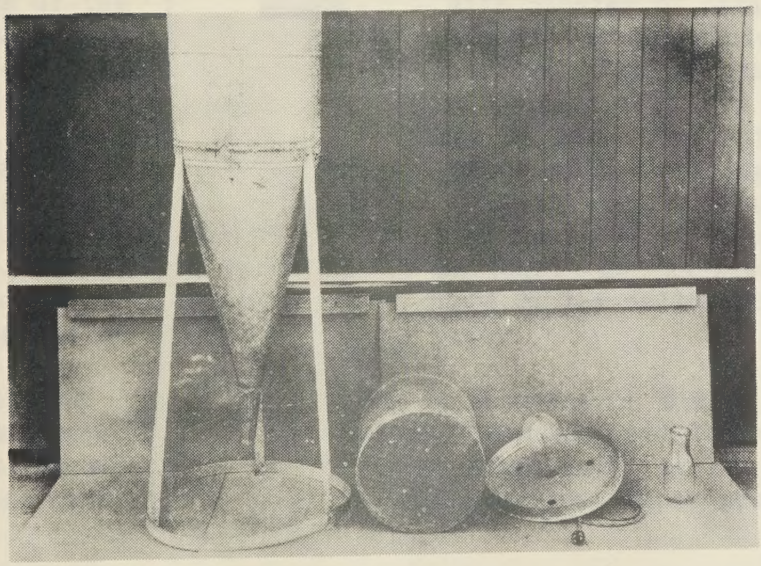


Figure 3.--Unassembled parts.